THE WEATHER AND CIRCULATION OF JANUARY 1968

Extreme Cold Followed By Rapid Warming at Mid-Month

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1. MEAN CIRCULATION

700-mb. heights were generally above normal over North America during January 1968, but were slightly below normal off the British Columbia and Labrador coasts in association with trough components in those areas (figs. 1 and 2). Only a weak trough in the Southern Plains remained of the deep feature which had dominated the Continent during December [1].

A highly amplified ridge-trough system persisting from the previous month over the eastern Atlantic and Europe continued to create frequent storminess and deploy cold Arctic air southward over Europe into the Mediterranean and North African areas. Early in the month storms produced heavy snow in southern England and a rare foot-deep snowfall in Jerusalem, and at mid-month a severe gale was accompanied by wind gusts of well over hurricane force in the northern British Isles.

A strong blocking ridge with heights more than 400 ft. above normal was located in the Aleutian-Bering Sea area (figs. 1 and 2). This feature was brought about by retro-

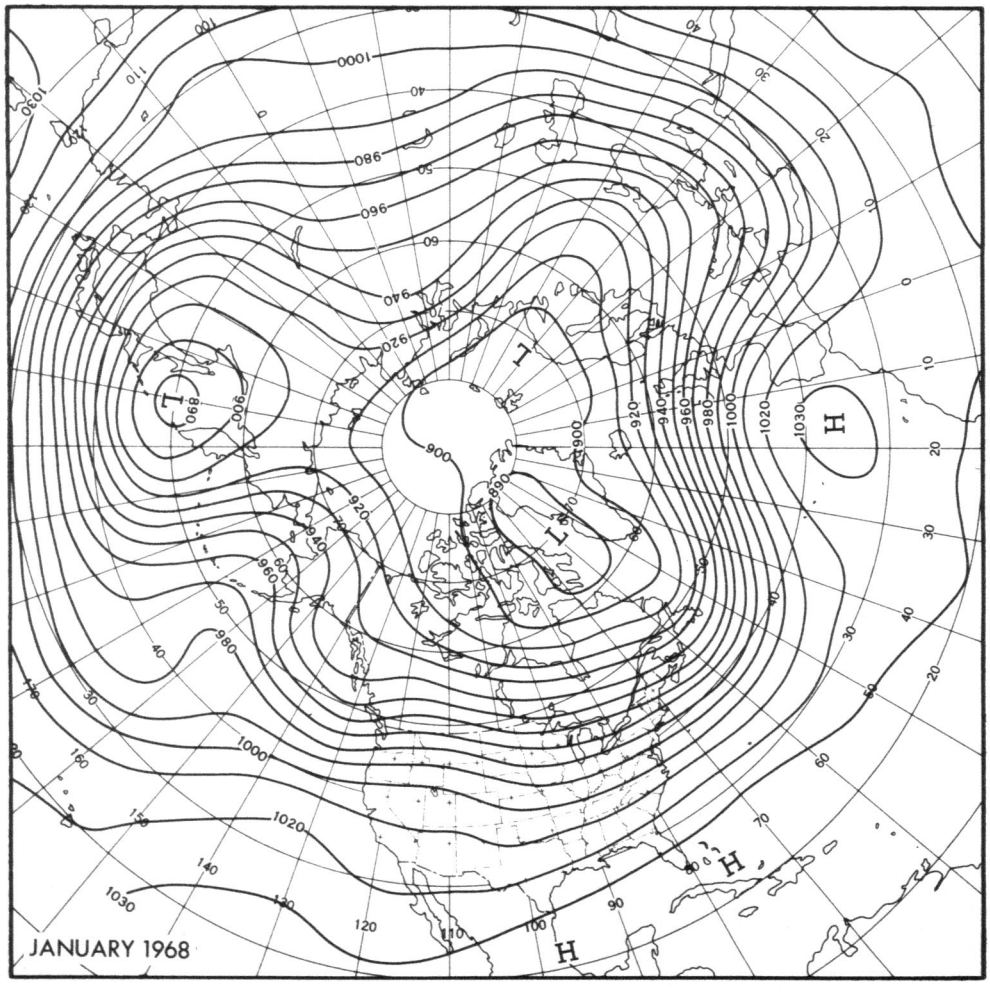


FIGURE 1.—Mean 700-mb. contours (tens of feet) for January 1968.

gression and northward building of a ridge component located in the eastern Pacific in December. The blocking ridge in central Asia and southward-displaced Kamchatka Low with abnormally deep troughs near Japan and west of Hawaii were features that persisted with little change from December to January. The trough near Hawaii was associated with an abnormally high frequency of thunderstorms at Honolulu and Kahului and a funnel cloud was observed over the bay at the latter station.

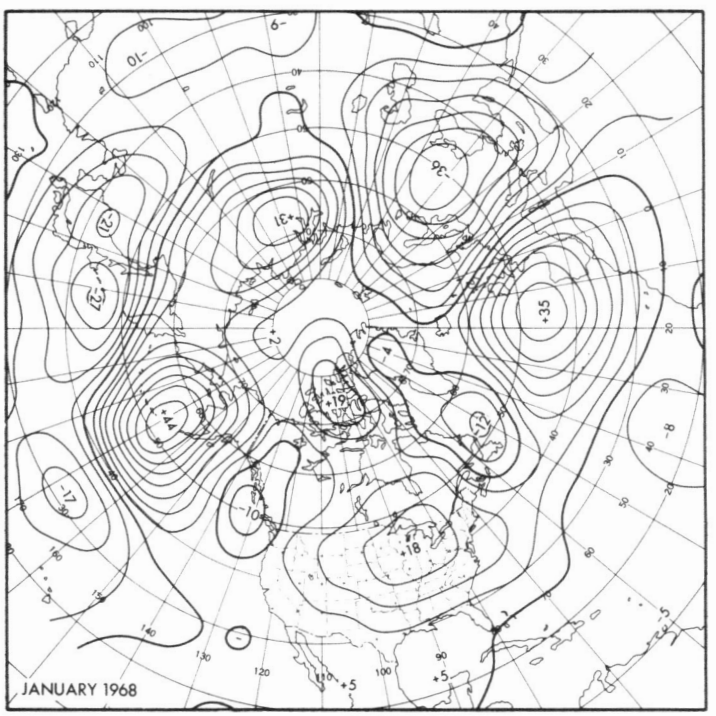


FIGURE 2.—Departure of mean 700-mb. height from normal (tens of feet) for January 1968.

2. MID-MONTH REVERSAL

The first 2 weeks of January were characterized by extremely cold weather over most of the Nation, particularly east of the Rockies. Although 700-mb. heights were above normal over most of North America a deep Low off Newfoundland associated with heights 320 ft. below normal served to transport extremely cold Arctic air from Canada to cover a large portion of the United States (fig. 3). Parts of New England had their coldest 2 weeks since 1934. Strong high latitude blocking extending from the Bering Sea to Greenland helped to displace the westerlies to lower latitudes and generate cold surface Highs which subsequently moved southward. The mid-latitude block in the eastern Atlantic combined with the extremely deep trough over Europe (480 ft. below normal) to produce most of the month's bad weather in Europe.

During the second half of the month 700-mb. heights rose dramatically over the central United States, the western Atlantic, and eastern Europe, thereby cutting off the flow of Arctic air in these areas as a broad area of zonally-oriented above-normal heights was established. Peak height values were 300 ft. above normal over the Midwest and 430 ft. above normal just west of the English Channel (fig. 4). Heights in the polar region fell rapidly to below normal, and a connection was made between the Asian and Bering Sea blocks. The Asian block strengthened markedly in the second half of the month, perhaps in delayed response to the extreme depth of the eastern

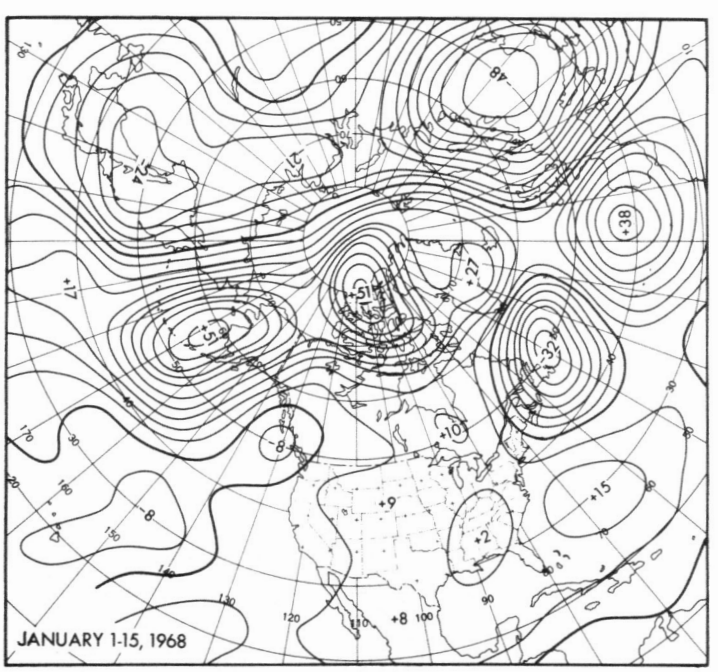


FIGURE 3.—Departure of mean 700-mb. height from normal (tens of feet) for first half of January 1968.

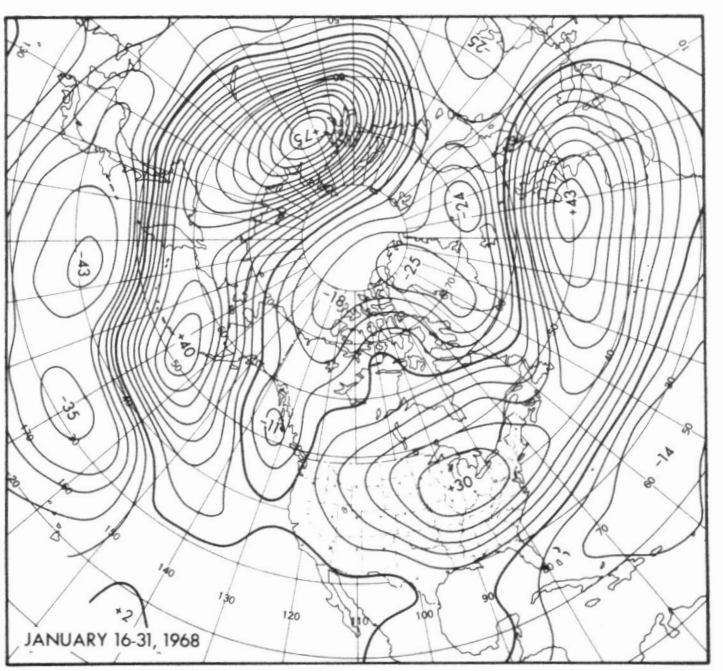


FIGURE 4.—Departure of mean 700-mb. height from normal (tens of feet) for second half of January 1968.

European trough in the first half of the month. The westerlies undercut the block in the western Pacific, where heights were more than 200 ft. below normal in a band extending from Korea to just north of Hawaii.

Although no dramatic height change occurred over the eastern Pacific between the two halves of the month, rapid cyclongenesis in the Gulf of Alaska around mid-month led to the initial ridging and rapid warming over the United States. The magnitude of this warming is perhaps most dramatically illustrated by the fact that the mean daily temperature at Rapid City, S. Dak., rose from 35°F. below normal on January 6 to 33°F. above normal on January 24, with a total monthly temperature range of 88°F., from −19°F. to 69°F. Several other cities in the central part of the Nation reported similar, although not quite so dramatic, moderations of temperature during the month.

The rapid warming also had a pronounced effect on the extent of the snow cover. During the week from January 15 to 22, the 1-in. snow line retreated over nearly the whole country (fig. 5). Greatest change was in the Central States, where the snow boundary moved from the Ozarks to central Wisconsin.

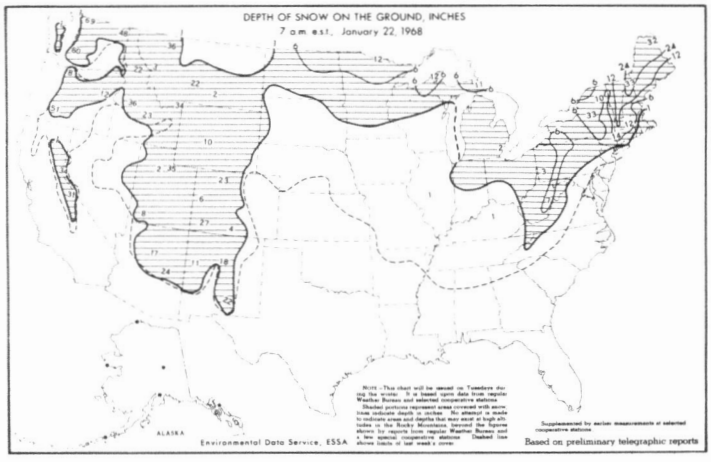


FIGURE 5.—Depth of snow on the ground in inches at 7 a.m., EST, January 22, 1968. Note rapid retreat of snow cover from position of a week previous, shown by the dashed line (from [2]).

3. TEMPERATURE

Even though monthly mean 700-mb. heights were above normal over most of the country (fig. 2), only the Far West and portions of the Great Plains and Northern Mississippi Valley had monthly mean temperatures above normal (fig. 6). Greatest positive departure of more than 4°F. were observed in the Columbia River Basin and northeastern Colorado. The coldest weather, relative to normal, occurred in the Northeast, where temperatures averaged as much as 8°F. below the monthly average. There, the marked warming trend which set in after mid-month was unable to outweigh the effects of the extreme cold weather of the first 2 weeks. A deep snow cover built up during the cold period (fig. 5) also delayed the effects of the warming by cooling the air near the surface, particularly in parts of the Appalachians and Ohio Valley. Although not so extreme at its peak, the cold in the Southeast was remarkably persistent. Freezing temperatures were observed on 22 days at Wilmington, N.C., the largest January total since 1875 when records began.

Unusually deep snow cover in portions of the eastern Plateau and Rockies also contributed to cold temperatures in those areas. The monthly mean temperature at Winslow, Ariz., was more than 18°F. below normal as a strong inversion, maintained by radiation over the persistent snow cover laid down in December's blizzard [1], was unbroken for most of the month. Temperatures at nearby Flagstaff, which actually had a deeper snow cover, were only 2°F. below normal due to the higher station elevation not favoring as much drainage of cold air, so that the inversion was frequently broken. The January mean temperature of more than 10°F. below normal at Grand

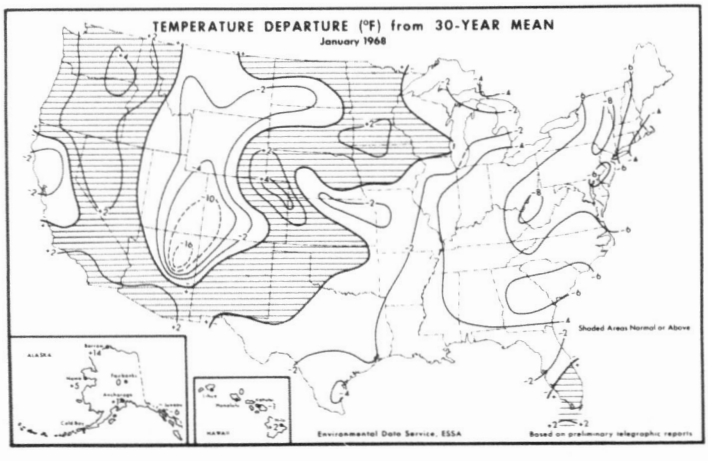


FIGURE 6.—Departure from normal (°F.) of average surface temperature for January 1968 (from [2]).

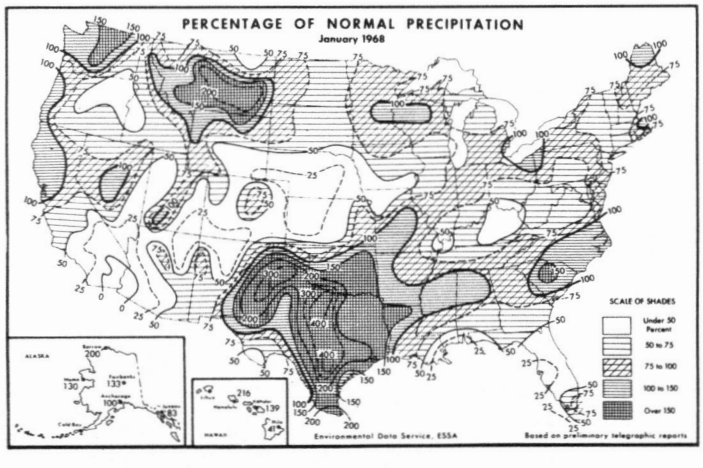


FIGURE 7.—Percentage of normal precipitation for January 1968 (from [2]).

Junction, Colo., was related to one of the longest cold spells of record at that station. Except for only a single day, daily temperature means were below normal continuously throughout December and until January 26.

4. PRECIPITATION

As might be expected with above normal 700-mb. heights and anticyclonic anomalous flow (fig. 2) precpiitation was somewhat below normal over much of the Nation (fig. 7). Driest areas relative to normal were near or slightly southwest of the maximum positive height anomaly in the central part of the Country, and in the Southwest where easterly anomalous flow resisted the incursion of the usual wintertime Pacific moisture and storm systems.

Heaviest precipitation, as much as four times normal, fell in parts of central Texas, mostly in connection with a slowly moving cutoff Low during the third week of the month (see weekly discussion below). The 8.51 in. observed at San Antonio was the greatest January total of record there. Another area of relatively heavy precipitation (more than twice normal) was in Montana, where cold air frequently banked up against the mountains and was overrun by relatively mild, moist air from the Pacific.

5. WEEKLY CIRCULATION AND WEATHER

JANUARY 1–7

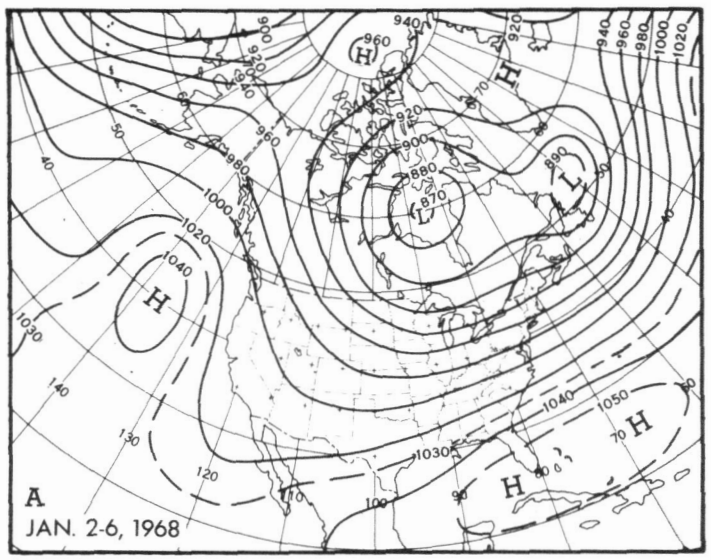
During the first week of the new year strong northwesterly flow between the deep, southward-displaced Canadian polar vortex and a ridge in the eastern Pacific spread cold air into most of the Country (fig. 8A, B). Only Florida, under a strong subtropical ridge, had temperatures substantially above normal.

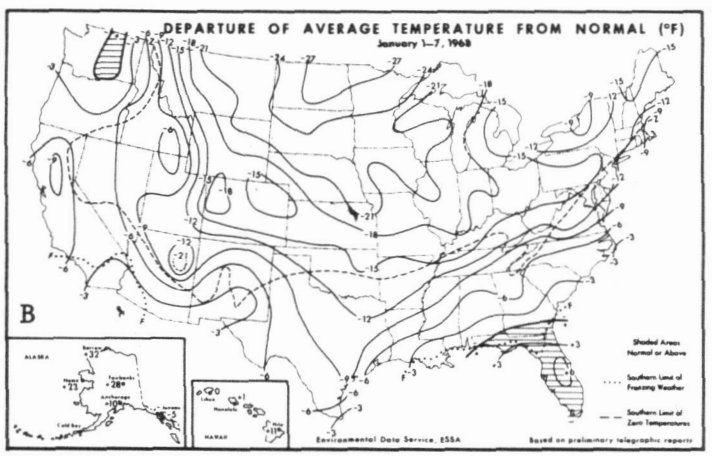
Coldest weather, both in an absolute and anomalous sense, was observed in the Northern Mississippi Valley and Northern Plains. Weekly temperatures averaged more than 27°F. below normal, with unofficial readings as low as −49°F. in Minnesota. At International Falls the temperature was 37°F. below normal on January 6, with the minimum of −44°F. equaling and the maximum of −19°F. shattering the all time records for cold. Daily cold records were also broken at several stations in the Midwest and New England.

Precipitation was light over much of the Country, except for the Southern Mississippi Valley, most of the Southeast, and the New England coast (fig. 8C). The eastern lobe of the Canadian vortex (fig. 8A) was related to the first of two blizzards which struck parts of the Canadian Maritimes.

JANUARY 8–14

During the second week of the month the ridge in the eastern Pacific retrograded to the Bering Sea with the usual concomitant development of a trough in the Gulf of Alaska (fig. 9A). Ridging began over the central part of North America at higher latitudes while the deep cold Canadian Low moved to a position just east of Newfoundland, where a second blizzard occurred.





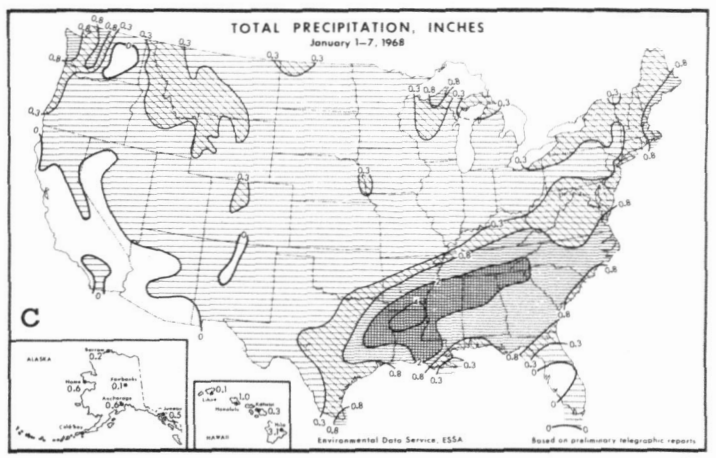
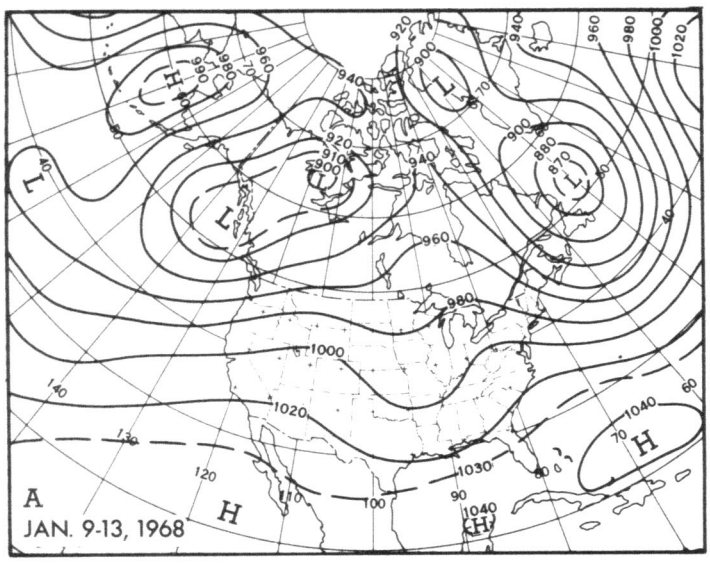
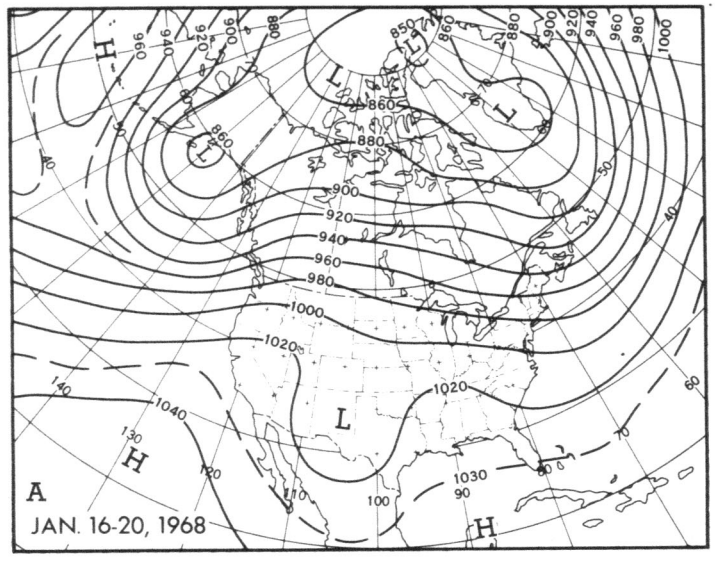


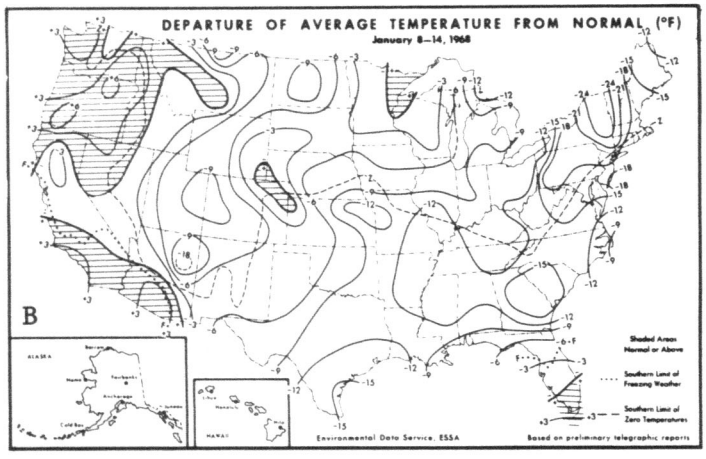
FIGURE 8.—(A) Mean 700-mb. contours (tens of feet) for January 2–6, 1968; (B) departure of average surface temperature from normal (°F.); and (C) total precipitation (in.) for week of January 1–7, 1968 (from [2]).

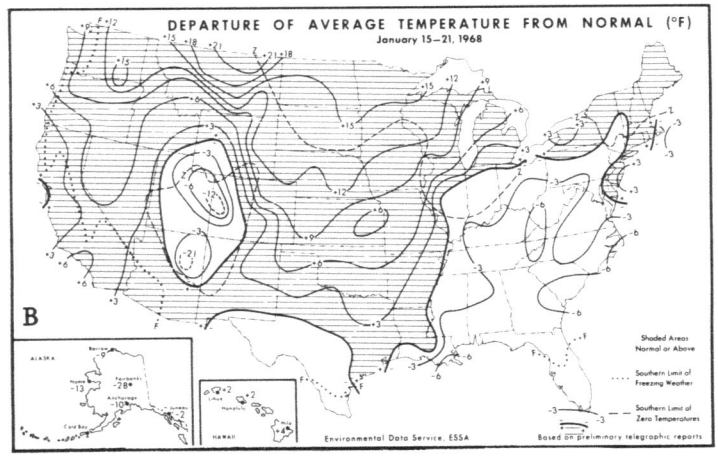
The main thrust of cold air was over New England and the northern Appalachians, where weekly temperatures averaged as much as 25°F. below normal (fig. 9B). Many records were set, not only for daily temperatures, but also for persistence of extreme cold. The temperature was below zero for 115 consecutive hr. at Burlington, Vt.—a new record siege of subzero cold. The week of January 7–13, with a mean temperature of only +2.1°F., was the third coldest January week of record since 1871 at Concord, N.H. The temperature dipped to −51°F. in the Adirondacks, within 1° of the all-time New York State record set in 1934. A reading of −26°F. on the 13th at Albany tied that city's all-time low temperature record.

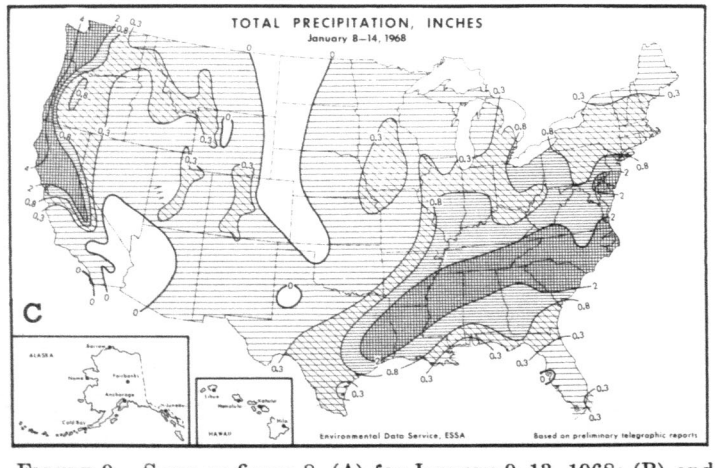
Following the development of the new trough in the Gulf of Alaska (fig. 9A) temperatures moderated over the whole Country except in the East and South, rising to above normal in the Far West. At the same time,











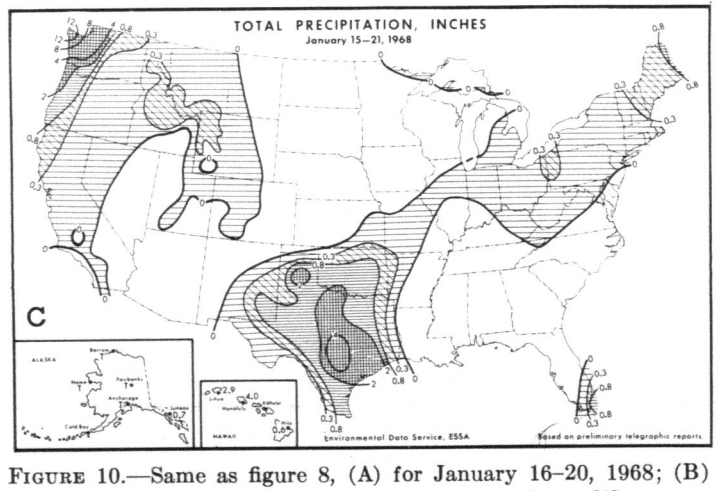
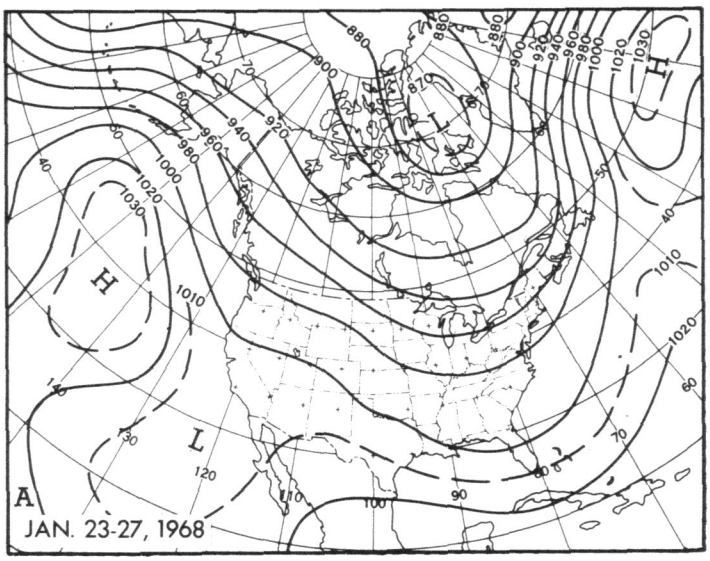


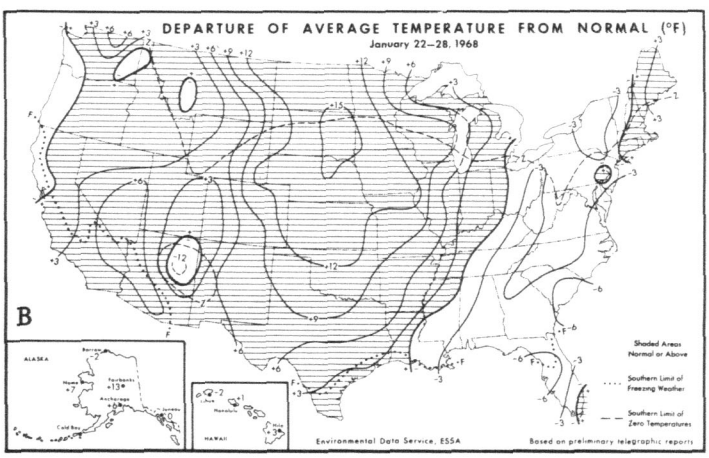
FIGURE 9.—Same as figure 8, (A) for January 9–13, 1968; (B) and (C) for week of January 8–14, 1968 (from [2]).

FIGURE 10.—Same as figure 8, (A) for January 16–20, 1968; (B) and (C) for week of January 15–21, 1968 (from [2]).

precipitation increased along the West Coast (figs. 9B, C).

Precipitation was also quite heavy in the Southeast, Mid-Atlantic States, and Ohio Valley. A series of frontal waves produced a damaging mixture of snow, sleet, and freezing rain in the interior of the Carolinas and northern Georgia. In connection with a slowly moving trough at lower latidudes (fig. 9A) a storm produced from 5 to 15 in. of snow in the Midwest and Central Appalachians, while heavy rain occurred east of the mountains and glaze in parts of the interior of New York and New England.





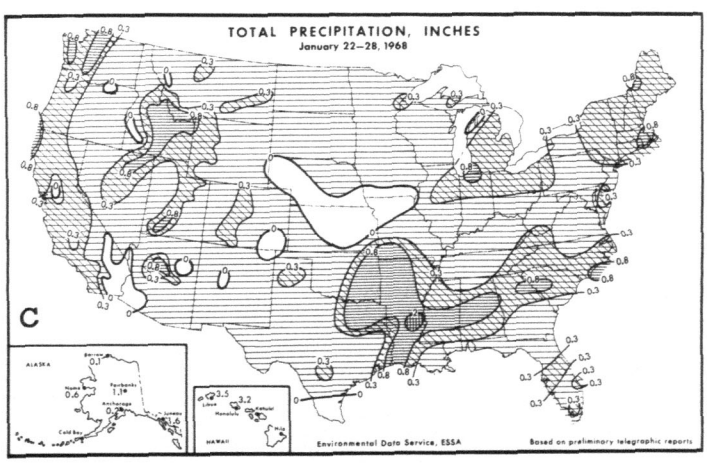


FIGURE 11.—Same as figure 8, (A) for January 23–27, 1968; (B) and (C) for week of January 22–28, 1968 (from [2]).

JANUARY 15–21

Retrogression occurred over the Eastern Pacific during the third week, with the Gulf of Alaska Low continuing to deepen (fig. 10A). Fast westerlies spread across southern Canada, with the result that practically the whole United States warmed rapidly, except for the Southeast and areas affected by abnormally heavy snow cover, such as the eastern Great Basin and portions of the Ohio Valley and Central Appalachians (fig. 10B). A strong southwesterly flow from the subtropical Pacific brought weekly rainfall in excess of 12 in. to portions of the Olympian Peninsula in Washington (fig. 10C), and the maximum temperature of 67°F. at Pendleton, Oreg., on the 19th equaled the record high for January at that station.

Chinook winds produced warm and dry conditions over the Northern and Central Plains (figs. 10B, C). However, the unusually long wavelength between the principal troughs west of Hawaii and off the Atlantic Coast favored the introduction of a low-latitude trough over the Southern Rockies (fig. 10A). This slowly moving system, which was cut off for several days, produced extremely heavy rains which led to considerable flooding over south-central Texas. San Antonio received over 3 in. in 24 hr. and had a storm total of over 7 in. Weekly rainfall amounts in some areas south of San Antonio exceeded 10 in. Preliminary estimates of flood damage were near three million dollars.

JANUARY 22–28

Mild conditions continued over most of the Country during the final week of the month, although a cooling trend had set in over portions of the East and Pacific Northwest by the end of the period, under the influence of troughs and flow from Canada (fig. 11A, B). The cold air supply in Canada had been considerably depleted by events earlier in the month, however.

Unseasonably warm weather occurred in parts of California the first part of the week. A temperature of 74°F. at San Francisco on the 23d was the highest ever recorded for that date, and 84°F. at Los Angeles on the 24th tied the daily record for warmth.

Precipitation was rather evenly distributed throughout the Nation with most sections receiving light or moderate amounts (fig. 11C). Heaviest rainfall occurred in the lower Mississippi Valley and parts of the Southeast. On the 25th and 26th a storm produced 6 to 10 in. of snow over eastern Massachusetts and Rhode Island, although little or no precipitation fell over the rest of New England.

REFERENCES

1. L. P. Stark, "The Weather and Circulation of December 1967—Temperature Reversal Associated With Intramonthly Amplification," *Monthly Weather Review*, vol. 96, No. 3, Mar. 1968, pp. 190–195.
2. Environmental Data Service, ESSA, *Weekly Weather and Crop Bulletin*, vol. 55, Nos. 2–5 and 7, Jan. 8, 15, 22, 29, and Feb. 12, 1968, pp. 1–8.